ER 44 – Electrician Regulations Answer Schedule

Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. - This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. - Symbols and terms - alternatives -
Power W or P -
Voltage V or E or U -
Phase Active -

Question 1	*Marks*	*Reference*	*Marking notes*
(a) Any TWO of:	(2 marks)		
• The part of the installation is electrically safe.		ESR 13(1)(a)	
• The work has not adversely affected the electrical safety of the rest of the installation.		ESR 13(1)(b)	
• Check that any associated equipment and personal protective equipment is in good order and condition.		ESR 100(1)(a)	
• Follow the procedures approved by the employer for the work to be carried out.		ESR 100(1)(b)	
• To use the associated equipment and personal protective equipment provided in a competent manner.		ESR 100(1)(c)	
• Before starting the installation, hold a declaration of conformity that complies with regulation 58 for that part of the installation.		ESR 57(2)(a)	
• Ensure that the installation complies with the relevant Part of AS/NZS 3000 identified in the declaration of conformity.		ESR 57(2)(b)	
• In the case of an installation designed under Part 1 of AS/NZS 3000, ensure that the installation is installed in accordance with the design indentified in the declaration of conformity.		ESR 57(2)(c)	
(b) • The installation must have at least one MEN switchboard.	(1 mark)	ESR 27(4)(a)	
• The switchboard located electrically closest to the point of supply must be an MEN switchboard.	(1 mark)	ESR 27(4)(b)	

Question 1	*Marks*	*Reference*	*Marking notes*
(c) Any TWO of: • Connected by a plug of suitable capacity. • Connected by a cord connector of suitable capacity • Connected by a permanent connection.	(2 marks)	ESR 88(1)	
(d) Any TWO of:	(2 marks)		
• Shall effectively isolate all active supply conductors.		AS/NZS 3000 2.3.2.2.1	
• Be capable of withstanding impulse voltages		AS/NZS 3000 2.3.2.2.1	
• Not be able to falsely indicate that the contacts are open.		AS/NZS 3000 2.3.2.2.1	
• Clearly and reliably indicate the isolating position of the device.		AS/NZS 3000 2.3.2.2.1	
• Be designed and installed to prevent unintentional closure.		AS/NZS 3000 2.3.2.2.1	
• Be capable of being secured in the open position.		AS/NZS 3000 2.3.2.2.1	
• Provide isolation of the electrical installation, circuits or individual items of apparatus as required for maintenance, testing, fault detection or repair.		AS/NZS 3000 2.1.2(a)	
(e) • Installed at the origin of every circuit.	(1 mark)	AS/NZS 3000: 2.5.4.2	
• Installed at each point where a reduction in the current carrying capacity occurs	(1 mark)	AS/NZS 3000: 2.5.4.2	
(f) • 16 mm^2	(1 mark)	AS/NZS 3000 3.12.2.2 Table 3.3	
• Not less than 7 strands	(1 mark)	AS/NZS 3000 3.12.2.2	
(g) Any ONE of:	(2 marks)		
• Sheathed, armoured and served cables. Neutral screed cables suitable as underground cables		AS/NZS 3000: Table 3.5	
• Armoured sheathed cables Neutral-screened cables		AS/NZS 3000: 3.11.3.1(d)	
(h) • Any ONE of:	(1 mark)		

Question 1	*Marks*	*Reference*	*Marking notes*
* IPX4 degree of protection.		AS/NZS 3000 6.3.4.1(c)	
* Provided with the required degree of protection		AS/NZS 3000 6.3.4.5	
● Any ONE of:	(1 mark)		
* Supplied individually as a separated circuit (isolating transformer)		AS/NZS 3000 6.3.4.5(c)(ii)	
* Supplied from a circuit protected by an RCD with a fixed rated residual current not exceeding 30 mA		AS/NZS 3000 6.3.4.5(c)(iv)	
(i) Because the maximum demand of the installation exceeds the current carrying capacity of the mains.	(2 marks)	GK	
(j) Any ONE of:	(2 marks)		
● To ensure that any fault on the low voltage system is not transferred into the extra-low voltage system.		GK	
● The extra-low voltage cables are not insulated to 230V		GK	
● To avoid any detrimental effects arising between circuits operating at different voltages.		AS/NZS 3000 3.9.8.1(c)	

Question 2	*Marks*	*Reference*	*Marking notes*
(a) (i) ● Prevent unintentional bodily approach to live parts.	(1 mark)	AS/NZS 3000 1.5.4.5(i)	
● Prevent unintentional contact with live parts during the operation of live electrical equipment in normal service	(1 mark)	AS/NZS 3000 1.5.4.5(i)	
(ii) ● Competent persons	(1 mark)	AS/NZS 3000 1.5.4.5(a)	
● Persons under the supervision of competent persons.	(1 mark)	AS/NZS 3000 1.5.4.5(b)	
(b) (i) Exposed conductive parts of the electrical equipment shall not be connected to the exposed conducive parts of: (1) Any other circuit. (2) Earth.	(2 marks)	AS/NZS 3000 7.4.5 1.5.5.5	
(ii) They shall not be simultaneously accessible with any exposed conductive part of the separated circuit	(2 marks)	AS/NZS 3000 7.4.6(d)	
(iii) By measurement of the insulation resistance between the separated circuit and the transformer primary winding and earth.	(2 marks)	AS/NZS 3000 7.4.7.1	

Question 3	*Marks*	*Reference*	*Marking notes*
(a) (i) (A) Final subcircuits that supply motors (inductive loads)	(1 mark)	GK	
(B) Any ONE of: ● Overcurrent protection is usually incorporated in the motor starters. ● Where more than one motor is supplied and each has its own overcurrent protection	(1 mark)	GK	
(ii) The water heater is not capable of causing an overload current.	(1 mark)	AS/NZS 3000 2.5.3.4(b)(ii)	
(iii) Any TWO of: ● Lifting magnets. ● Exciter circuits of machines. ● Secondary circuits of current transformers	(2 marks)	AS/NZS 3000 2.5.1.3 Note 1	
(b) ● The efficient and effective isolation of the electricity supply from an electrical installation ….by persons …. in the event of an emergency arising that requires prompt isolation..	(1 mark)	AS/NZS 3000 2.3.3(a)	
● Maintenance of supply to safety services during an emergency that may require, or result in, isolation of supply from other portions of the electrical installation.	(1 mark)	AS/NZS 3000 2.3.3(b)	
(c) Any TWO of: ● Shall be marked “MAIN SWITCH” ● By means of grouping. ● Contrasting colours	(2 marks)	AS/NZS 3000 2.3.3.4(a)	
(d) The submain shall be controlled by an isolating switch in the switchboard at which the circuit originates.	(1 mark)	AS/NZS 3000 2.3.4.2	

Question 4	*Marks*	*Reference*	*Marking notes*
(a) (i) All of the work	(1 mark)	ESR 65(1)	
(ii) Section 8 of AS/NZS 3000	(1 mark)	GK	
(b) • The relocated meter box and fittings. • The new internal mains. • The new main earthing lead and earth electrode. • The new socket outlet on the outside of the house. • The additional lights installed in the living areas. • The additional power points installed in the living areas	(3 marks)	ESR 66(1), (3)	
(c) (i) • 3 working days	(½ mark)	ESR 67(4)	
• After the completion of the work	(½ mark)	ESR 67(4)	
(ii) • 20 working days	(½ mark)	ESR 68(1)	
• After the completion of the certificate.	(½ mark)	ESR 68(1)	
(iii) Any THREE of: • The installation is electrically safe. • The work was done in accordance with the Act and regulations. • The installation has been installed in accordance with a design prepared in accordance with Part 2 of AS/NZS 3000 • The declaration of conformity has been sighted. • Particular tests have been satisfactorily completed. • The rating of the earthing system is correct. • Fittings are safe to connect to the electricity supply. • The installation is safe to connect to the electricity supply.	(1½ marks)	ESR 67(1), (2)	

Question 4	*Marks*	*Reference*	*Marking notes*
(d) • The relocated meter box and fittings. • The new internal mains. • The new main earthing lead and earth electrode.	(1½ marks)	ESR 70(1)(c)	

Question 5	*Marks*	*Reference*	*Marking notes*
(a) Provided against dangers that may arise from contact with exposed conductive parts that may become live under fault conditions	(1 mark)	AS/NZS 3000 1.5.5.1	
(b) (i) Intended to limit the prospective touch voltage arising between simultaneously accessible conductive parts in the event of a fault between a live part and exposed conductive parts or a protective earthing conductor.	(2 marks)	AS/NZS 3000 1.5.5.3(a) 2.4.2 5.2.1 Appendix B: B4.2	
(ii) A protective device shall automatically disconnect the supply to the circuit or electrical equipment concerned.	(2 marks)	AS/NZS 3000 1.5.5.3(b)	
(c) (i) 4 mm^2	(½ mark)	AS/NZS 3000 5.3.3.2	
(ii) 1 mm^2	(½ mark)	AS/NZS 3000 5.3.3.4(b)	
(d) (i) The circuit shall only be used for the earthing of equipment supplied from the circuit.	(2 marks)	AS/NZS 3000 5.5.2.2.1	
(ii) It shall not be used for the earthing of electrical equipment that is supplied from another switchboard.	(2 marks)	AS/NZS 3000 5.5.2.2.3	

Question 6	*Marks*	*Reference*	*Marking notes*
(a) (i) The rating shall not be less than the greater of: ● One-third of the rating of the motor circuit conductors; or ● 135% of the rated current of the capacitor.	(2 marks)	AS/NZS 3000: 4.15.2.3(i) and (ii)	
(ii) Any ONE of: ● A smaller cable can be used to supply the motor. ● Less voltage drop ● Less heat loss ● Less current	(1 mark)	GK	
(b) (i) Any ONE of: ● 15.78A ● The full load current rating of the motor. ● 126.24A	(1 mark)	AS/NZS 3000: 4.13.1.2(a)	
(ii) ● 8 x 15.78	(1 mark)	AS/NZS 3000: 4.13.1.2(i)	
● = 126.24A	(1 mark)		
(c) (i) Any ONE of: ● The switching devices shall be isolating switches. ● Shall consist of a single switching device directly interrupting the incoming supply. ● Shall consist of a combination of several items of electrical equipment operated by one single action.	(2 marks)	AS/NZS 3000: 2.3.5.1 AS/NZS 3000: 2.3.5.2(a) AS/NZS 3000: 2.3.5.2(b)	

Question 6	*Marks*	*Reference*	*Marking notes*
(ii) Any TWO of: ● Shall be capable of breaking the full-load current of the motor, taking account of the stalled motor current. ● Shall be manually operated directly interrupting the motor-supply circuit. ● Be provided with a means of operation capable of latching or being restrained in the "OFF" or "STOP" position. ● Shall not re-energise the motor-supply circuit upon release of the device. ● Shall be reset manually before the motor can be started.	(2 marks)	AS/NZS 3000: 2.3.5.2	

Question 7	*Marks*	*Reference*	*Marking notes*

Equipment	**Load Group**	**Calculation**	**Load in amps**	**Marks**
14, 100W lights	A(i)	(14 x 100) ÷ 230 = 6.08	6.08	(1 mark)
4, 0.3A fluorescent lights	A(i)	4 x 0.3 = 0.9	1.2	(½ mark)
6m lighting track	A(i)	0.5 x 6 = 3	3	(½ mark)
3kW outside light	A(ii)	(3000 ÷ 230) x 0.75 = 9.78	9.78	(1½ marks)
20 single socket outlets	B(i)	20 points @ 10A	10	(1 mark)
1 10A socket outlet (Gas WH)	B(i)	1 point @ 5A	5	(1 mark)
2, 15A socket outlets	B(ii)	2 points @ 10A	10	(½ mark)
8kW electric range	C	(8000 ÷ 230) x 0.5 = 17.39	17.39	(1½ marks)
6KW air conditioner	D	(6000 ÷ 230) x 0.75 = 19.57	19.57	(1½ marks)
Total			82.02	(1 mark)

Note: Any total between 81A and 84A is acceptable. -

Question 8			*Marks*	*Reference*	*Marking notes*
(a)	A situation in which moisture is either permanently present, or intermittently present to such an extent as would be likely to impair the effectiveness or safety of an electrical installation which complies with this Standard for ordinary situations.		(2 marks)	AS/NZS 3000: 1.4.40	
(b)	Any ONE of:		(2 marks)		
	•	A degree of protection in accordance with AS 60529.		AS/NZS 3000: 1.4.61	
	•	The degree of protection of an item of enclosed equipment as an IP (International Protection) rating, in accordance with AS 60529.		AS/NZS 3000: Appendix G: G1	
(c)	5	Limited ingress of dust permitted (no harmful deposit).	(1 mark)	AS/NZS 3000: Table G1(a)	
	4	Protected against water splashed from all directions. Limited ingress permitted.	(1 mark)	AS/NZS 3000: Table G1(b)	
(d)	(i)	No IP rating	(1 mark)	AS/NZS 3000: 6.2.4.1(c) Table 6.1	
	(ii)	IPX4	(1 mark)	AS/NZS 3000: 6.2.4.1(b) Table 6.1	
	(iii)	• Heated towel rail IPX4	(1 mark)	AS/NZS 3000: 6.2.4.1(b) Table 6.1	
		• Permanent connection unit IPX 4	(1 mark)	AS/NZS 3000: 6.2.4.1(b) Table 6.1	

Question 9	*Marks*	*Reference*	*Marking notes*
(a) $I = \frac{P}{\sqrt{3}\ x\ 400}$	(½ mark)		The answers in (a), (b) and (c) must relate to a copper cable (as required in the question)
$= \frac{60000}{\sqrt{3}\ x\ 400}$	(½ mark)		
$= 86.6A$	(½ mark)		
Load growth = 86.6 + 20% = 103.92 amp	(½ mark)		
From Table 13 the rating for 16 mm^2 is 106 amps.	(½ mark)		
From Table 27(2), the re-rating factor for 10^0C is1.04	(½ mark)		
The maximum load can be carried by the 16 mm^2 cable is:	(½ mark)		
= 106 x 1.04 = 110.25A			
The 16 mm^2 will satisfy the load requirements.	(1 mark)		
(b) Maximum volt drop permitted = 6 V (400 x 1.5%)	(1 mark)		
$V_d = \frac{mV/A.m\ x\ A\ x\ m}{1000}$	(½ mark)		
$mV/A.m = \frac{V_d\ x\ 1000}{A\ v\ m}$			
$= \frac{6\ v\ 1000}{103.92\ x\ 60}$	(½ mark)		
= 0.9623 mV/A.m	(1 mark)		
From Table 42 a 0.9623 mV/A.m equates to a 50 mm^2 cable	(½ mark)		
A 50mm^2 cable will meet the voltage drop requirements	(1 mark)		
(c) A 50mm^2 cable will meet the load and voltage drop requirements	(1 mark)		